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Printing Troubles

As we have feared it would, these last three weeks, the dispute in the printing trade has now gone so far that in the London area it amounts to a complete stoppage. Only apprentices have been available to us to compose, make-up and print this issue. They have, readers will, we think, agree, done very well. But they are so few in number that they cannot do much. How long we shall have to depend on them alone we do not know. But at least there is now hope of an ending of the troubles. The Minister of Labour has appointed courts of inquiry to examine the disputes in the industry; and if past experience is any guide the reports of these courts should lead to the re-opening of negotiations.

Restrictive Practices

Owing to the printing troubles referred to above it is impossible for us even adequately to summarize the provisions of the Restrictive Trade Practices Bill laid before Parliament last week, far less to give it the more extended notice it deserves. In the circumstances we can only advise all those within industries exercising any kind of practice that might be deemed restrictive to obtain and study a copy of the Bill. In essence it requires that restrictive trade practices of certain kinds but not including restrictions relating exclusively to exports or to overseas trading "or which relate to employment, wages, hours and conditions of work" shall be publicly registered; and that a judicial tribunal shall subsequently determine whether or not they are in the public interest, the onus of proof that a practice is justified being laid on those who practise it. There are interesting provisions about resale price maintenance. Room for adequate discussion is denied to us. We can but direct attention to certain more fundamental questions that may be asked. How, for example, is the national interest to be defined? Is a legal mind really well fitted to decide what is and what is not in the national interest? Will it really prove possible to enforce decisions of the Restrictive Practices Court? Are the grounds on which it can be pleaded that a restrictive practice is not harmful to the national interest sufficiently embracing? Or alternatively are too many loopholes left open for industries operating harmful practices to escape? The Bill, it will be observed, does not apply at all to trade union practices, some of which appear certainly to be as harmful as those operated by industry. Can it be hoped that when this Bill has become an Act a measure will be devised to bring these practices under examination in a similar way?

Proposed Engineering Building at University College

Plans have been announced for the construction of a new engineering building for University College, London on a site adjoining the existing building in Gower Street. The college authorities have made an appeal to industrial concerns for donations towards the cost of the new buildings, which will be about £2,000,000 for the complete scheme; a first stage is to be undertaken however, as soon as £300,000 is raised and two additional buildings, including a tower block of twelve storeys, will be added later. University College suffered heavily during the war, and extensive reconstruction has been carried out since. However, it has not been possible before to extend or modernise the engineering departments, which, we are informed, have hardly been extended for thirty years, and are now inadequate. About seventy engineering students graduate annually at University College at present. With the first stage of the new scheme complete it is expected that a fifty per cent increase will be achieved, and with the scheme in full operation, an annual intake of about 200 students, including candidates for higher degrees, and a total accommodation of about 600, are envisaged.

British and American Firms' Collaboration in Atomic Power

An agreement was announced last week between Mitchell Engineering Ltd. of London and Peterborough and A.M.F. Atomic Inc. of New York, covering the design and construction of nuclear power plants in the Commonwealth and other countries. This agreement is the first of its kind involving British and U.S. companies. We learn that the initial effort of the two firms is being directed towards the closed-cycle boiling-water reactor using natural uranium for electrical outputs of 60 MW upwards, and slightly enriched uranium for smaller electrical outputs for which the size of the reactor vessel becomes a determining economic factor. In any power plant schemes that may be undertaken jointly by the two companies, collaboration is likely to be based on the ability of A.M.F. Atomics Inc. to design and supply the reactors, fuel elements and electronics components, and of Mitchell Engineering Ltd. to carry out the civil engineering and constructional work. A.M.F. Atomics Inc. is a subsidiary of the American Machine and Foundry Company and was formed in April 1955 to extend the company's activities in atomic energy.

Another interesting announcement made last week was that the two British firms constituting the A.E.I./John Thompson Nuclear Energy Group are building Britain's first privately owned research reactor. It is to be installed at the Associated Electrical Industries' Research Establishment at Aldermaston Court in Berkshire, where a site for the reactor has been cleared and levelled and design work has been completed. It is a water-moderated "swimming pool" reactor known as "Merlin" (Medium Energy Research Light-Water-Moderated Industrial Nuclear Reactor) and it is suitable either for research and engineering studies or for training. The fuel, to be provided by the U.K. Atomic Energy Authority, will be uranium (4·5kgm U 235) arranged in twelve plates in a box about 3in by 3in by 24in, the fuel elements being clad in aluminium of 0·02in wall thickness. Water is used for moderator, coolant, and reflector. The core dimensions are 2ft 3in square by 2ft and the shielding is provided by 13ins of water surrounded by 6ft 3in wall thickness of barytes concrete, with a minimum of 18ft 6in of water above the core. The total thermal power is given as 1 MW normal, 5 MW maximum. The design was started in May, 1955 and the reactor is due to become critical in 1957.

Economic Measures

A statement on the economic situation was made in the House of Commons on Friday last by the Chancellor of the Exchequer, following the announcement on the preceding day that the Bank rate had been increased to 5½ per cent. The Chancellor said that this was a timely move which would reinforce the further disinflationary measures on which the Government had decided. He then announced measures which included the suspension of the existing investment allowance and its substitution by the restoration of the former initial allowance. The Chancellor explained, however, that capital expenditure on the construction of ships and on scientific research assets would continue to qualify for investment allowance. Other measures announced by the Chancellor were a reduction of the Government subsidies on bread and milk, further restrictions on hire purchase, and a reduction of the capital projects undertaken by the Government and the nationalised industries. The reductions it had been possible to make in the capital expenditure of the Government and of the nationalised industries, the Chancellor said, would reduce the pressure of demand in 1956 by about £70,000,000, and the savings on the food subsidies would amount to £38,000,000.

Engineering Wages

No settlement was reached over engineering wages at a meeting last Friday between representatives of the Engineering and Allied Employers' National Federation and the Confederation of Shipbuilding and Engineering Unions. At the beginning of last November, the Confederation submitted a claim for a "substantial increase" in the wages of those employed in the engineering industry. No actual amount was then specified, but at a meeting between the two sides on December 29th, the union representatives pressed for an increase of 15 per cent. The employers' representatives made their response to that demand last Friday when they offered increases of 11s. a week for skilled men, 9s. 6d for semi-skilled, and 8s. 6d for unskilled men. These amounts are approximately 7 per cent on existing rates. The union representatives, however, intimated that these proposals were not acceptable. It is understood that the situation was to be considered by the management board of the Employers' Federation yesterday (Thursday) and that a special meeting of union executives will be held next week for further discussion of the matter.

LITERATURE

Practical Construction of Warships. Second edition. By R. N. NEWTON. London: Longmans Green and Co., Ltd., 6–7, Clifford Street, W.1. Price 50s.

In the modern world it is the fate of all books dealing with the practical side of a profession that they become rapidly out of date, obsolescent, if not completely obsolete. This is certainly true of shipbuilding, and particularly so of warships, because not only is there changing practice brought about by the formulation of new ideas and the development of new processes, but also the fact that completely new types of vessels are required to meet the changing conditions of modern naval warfare. For example, it seems unlikely that new designs of the battleship as we know it, will be produced for the British Navy, H.M.S. "Vanguard," despite her name, probably being the last of her type.

It is therefore no surprise that since this book was first published in 1921 and has gone through six impressions, the author has found it necessary for this new edition to revise considerably the text and to include additional chapters. The chapters on welding and on ventilation have been rewritten and that on submarines is entirely new. It should be said at once that Mr. Newton has done his work well. The text is written with a laudable economy of words, and the diagrams and sketches, of which there is a wealth, are clear and adequate. The book is a veritable gold mine to the student faced with "sketch and describe" at his examination.

In his preface the author gives the wise advice to read the first chapter in Part III first. This reviewer neglected to follow that advice and in consequence found himself faced with terms such as "fore poppet," "½-block-model," &c., which had not been previously defined. Some of these are indeed explained in later sections, but it is suggested that there is a tendency at times to assume previous knowledge which is disconcerting to the student, who should be recommended to read first even more than the first chapter in Part III.

To consider a few details. In the sketch on page 18 the edge of the outer flat keel should be indicated as caulked; this is implied in paragraph 2, page 41, of the text. On page 23 no reason is apparent for the different treatment of the butts of the vertical keel, and those of the other watertight longitudinals.

The sketch showing supports to armour belt is correct, but mention should be made in the text that the main supports should be at the armour joints. For the protective bulkhead, in principle, the stiffeners should be on the inboard side; this is not stated and the sketch is not entirely clear, but suggests that the stiffeners are on the outboard side.

On page 40 the butts of O.B. plating are surely strapped on the inside and not on the outside, as stated.

The sections on metal arc welding and on all-welded construction are very good. The author very rightly stresses the importance of careful preparation of the joints. Whether the working of crack arresters—so-called—as mentioned on page 146, is the final answer to a difficult problem, it is as yet too early to say.

The section on ventilation, as already stated, has been largely rewritten. It is well done, but it is suggested that the sketch of the louvre on page 234 is hardly adequate.

The narrative on submarines is masterly and shows the hand of the expert. This is not surprising when one finds on the back flap of the dust cover that the author has been so intimately associated with the submarine service. Indeed, these chapters are very interesting reading to the complete layman, although he might be confused by the references sometimes to radio and at others to radar.

On pages 448, 449 it might have been mentioned among the advantages of using the flight deck as the strength deck, that it results in an appreciable saving in hull weight.

A few misprints have been noted. But these are very minor blemishes of an excellent textbook which in all probability will again run into many impressions before the next edition becomes due. It can be recommended with the utmost confidence.

Technical Education. By P. F. R. VENABLES. London: G. Bell and Sons, Ltd., York House, Portugal Street, W.C.2. Price 42s.

THIS book, though easily readable, is as tightly packed with information as is "Bradshaw," and must have been more difficult to write. For the railway timetables record intentions that are fixed for a specified period, whereas technical education is constantly changing. The author, despite experience and vision, has clearly found it impossible to present a clear-cut picture of something that is far from static. Extensively though he writes on many topics, he always adds a long bibliography as if to emphasise that very much more is on record and that readers would be wise to examine it all. The book contains a valuable compendium of British technical colleges, of present practices in organisation of their work and of tentative developments and possibilities. The author assembles facts in a manner that is sometimes tabular but more frequently discursive, and leaves the reader to judge, with what aid he elects to obtain from the voluminous bibliography, what is likely to happen and what he thinks should happen.

Although the author is better able to predict than most others and probably has strong views, he has not obtruded them. One could wish that he had been less modest in this respect. One could wish for a compact summary of future needs, even though it were largely opinion, following a compact summary of the present activities of technical colleges. The reader may produce these after some little study of the book, but the author could do it more efficiently. The book contains sections by specialist writers on Engineering, Building, Art, Women in Further Education, and Commerce, but these together comprise less than a quarter of the book, in which the author himself covers the wide field of the subject with an easy competence commensurate with his reputation.

The book should be in the hands of everyone concerned in education that is in any degree technical. As a storehouse of information on the present position it is invaluable. It is a means whereby anyone faced with a question about technical education may assemble facts and opinions from which an answer to the question may be deduced. In some cases the book gives an answer, but in many cases it does not. Everywhere one gains the impression of fluidity, adaptability, experiment, change and the need for change in methods in technical education. "It lacks," writes the author, "neither problems nor promise."

The Supervision of Civil Engineering Construction. By A. C. TWORT, A.M.I.C.E. London: Edward Arnold (Publishers), Ltd., 41, Maddox Street, W.1. Price 25s.

THE duties and responsibilities of a resident engineer on a civil engineering job are explained in this book. Apparently no book on this subject has been published before. The subject is in three main divisions, namely, "Site Organisation," which includes five chapters on contract organisation, office routine, and the resident engineer's duties; "The Work Progresses," a section devoted to explanations of practical matters in the supervision of the various classes of work, including setting out, concreting, brickwork and so forth, and finally, "Preparation of Contract Documents." The bibliography should also be mentioned, as it lists some essential volumes needed in the site office.

The text is essentially practical and undoubtedly has been written from a background of considerable experience, so we can endorse Mr. Gourley's remark, in his preface, that "the young engineer embarking as a resident engineer for the first time, will find in this book a guide, philosopher and friend." The contractor's agent or engineer, too, might find it worth some study.

The opening chapter states "This book deals with the supervision of medium-sized civil engineering work executed by fixed-price contract. It does not deal with prime-cost contracts, lump-sum contracts, civil engineering works executed by direct labour, or contracts of a special nature." Some explanation on all these other classes of contract, even if reduced to a single chapter, would perhaps have given a better perspective to the rest of the text, and might make a suitable addition to a future edition.

It is of interest to see examples of claims for extra payment discussed, with the reasons given for the decisions about them. Other chapters in the second section give information on standards of workmanship and quality which can be expected. Concrete work and pipelaying are dealt with, but the other classes of work relate rather to building construction, and there is practically no information on several classes of civil engineering work—for instance, on piling, or on structural steelwork.

Books Received

The Casting of Steel. Edited by W. C. Newell. London: Pergamon Press, Ltd., 4-5, Fitzroy Square, S.W.1. Price 105s.

Thermodynamics. By J. L. Finck. London: Thames and Hudson, Ltd., 244, High Holborn, W.C.1. Price 50s.

Electrical Interference. By A. P. Hale. London: Heywood and Co., Ltd., Drury House, Russell Street, W.C.2. Price 15s.

Mains Practice. By T. H. Carr. London: George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Price 35s.

Petroleum and its Combustion in Diesel Engines. by J. Lamb. London: Charles Griffin and Co., Ltd., 42, Drury Lane, W.C.2. Price 26s.

Switching Relay Design. By R. L. Peek, jun., and H. N. Wagar. London: Macmillan and Co., Ltd., St. Martin's Street, W.C.2. Price 70s.

Mine Rescue Work. By R. McAdam and D. Davidson. Edinburgh: Oliver and Boyd, Ltd., Tweedle Court, Edinburgh, 1. Price 21s.

Handbook of Engineering Materials. By D. F. Miner and J. B. Seastone. London: Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 140s.

Fifth Symposium (International) on Combustion. By The Combustion Institute. London: Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 120s.

Work Design and Training for Future Industrial Skills

By N. H. MACKWORTH, M.B.Ch.B., Ph.D.

No. II—(*Concluded from page 222, February 17th*)

In his 1955 Sir Alfred Herbert paper, delivered before the Institution of Production Engineers on February 9th, and from which abstracts are here printed, Dr. Mackworth considered, first, what is known about human fallibility in relation to inspection processes. He went on to consider the kinds of operations likely to be imposed upon human beings by the coming of automation, and to discuss the training of maintenance workers and the future supply of electronic staff.

Work Design for Decision Taking

A classic example of a factory which gives a glimpse of the future for industry is to be found in the plant for making car pistons on the outskirts of Moscow. " This factory, which supplies pistons for the entire Russian light car industry, is worked by a staff of nine men on each shift, i.e. *one general controller at the electronic nerve centre ;* a labourer who loads aluminium ingots on to a conveyor at the beginning ; two machine minders on the line ; and five skilled maintenance men. Apart from the initial loading, all processes and all transfers throughout the 50-yard line are entirely automatic." (Lilley, 1955.)

Suppose now we consider various aspects of the work of this " general controller at the electronic nerve centre." He is said to belong to the highest industrial rank and indeed a great deal depends on the effectiveness of this one individual, who is a key man if ever there was one. The whole process is under his care from the melting of the metal to the packing of the finished pistons.

The main task for the controller is related to the locating of any breakdown in the production line. " Practice in operating automatic machine tool lines and the automatic factory shows that with correctly arranged maintenance and repair of the electrical equipment correction of maladjustments arising in the operation of the electrical equipment and electric automatic devices can be carried out comparatively quickly. Considerably more time is normally expended in establishing the cause of the maladjustment and identification of the defective apparatus. Actually with a very large number of apparatus taking part in the working cycle of the line the complex control circuit and the great extent and ramification of the control circuits, quick determination of the cause and location of a fault is sometimes a matter of considerable difficulty and a task only for highly qualified maintenance personnel. From this point of view correct construction of the control system and a circuit facilitating rapid fault location is very important. . . ." (Zusman and Minsker, 1952.)

" An automatic control system provides automatic signalling which indicates the unit responsible for malfunctioning of the line or section. This at once greatly reduces the field of search and makes it possible by quickly examining the elements of the unit in question to find and consequently to correct the defect. Special (automatic) fault finders for finding faults within individual machine units, as practical working has shown, did not justify themselves and were subsequently omitted." (Zusman and Minsker, 1952.)

The controller has, in fact, to send in the maintenance men to look at the particular machine unit causing the trouble. How does he do this ? He sits at a desk. This provides him with a panoramic view of the factory, which shows the state of the equipment at a glance. Under a transparency are sections arranged to correspond to each machine unit. Each of these sections can show one of three signals :—

(1) *Dark.*—" Machine unit not switched on."
(2) *Light.*—" Machine on."
(3) *Bright.*—" Emergency here."

The same code is used on the corresponding machines. Some details on the electrical arrangements may be of interest. Each section in the desk panel contains two groups of 24V d.c. flashlight bulbs which are connected in series with the circuit for the corresponding machine unit.

(1) *Dark.*—No current passes through the lamps for that section because the given machine unit is not switched on.

(2) *Light.*—As soon as the knife switch on the machine unit is switched on, an intermediate control relay is connected and connects both groups of lamps in the corresponding section. The lamps in that section therefore light at half brilliance.

(3) *Bright.*—Each machine has an emergency relay which short circuits an additional resistance. The second group of lamps in that section therefore burns at full brilliance (Zusman and Minsker, 1952).

The controller can also look at a row of twenty-five four-figure telephone counters. These are continuously adding up the output at different stages along the line and give the present production position as regards :

(1) Number of ingots fed into smelter.
(2) Number of blanks cast.
(3) Number of pistons undergoing heat-treatment.
(4) Number of serviceable blanks and rejects checked for hardness.
(5) Number of tinplated pistons.
(6) Number of pistons sorted into groups.
(7) Number of boxes packed.

This type of display for general industrial control may become more common in the years to come. There are a number of decision-taking problems of very great interest in a situation of this kind. Some of these jobs are basically machine-paced tasks in which the controller has to select the correct orders based on the information, all of which is on the panel in front of him, and he has to do this as quickly as possible. He has, in fact, to search for a series of decisions to ensure that a number of objects arrive at the right place at the right time. A laboratory task has been devised which presents a similar problem for analysis. People have to search through a display panel to find urgent decisions which, if taken correctly, will ensure that the movable objects on the panel will arrive at their various destinations according to a definite timetable.

One problem is that of the pace set for the task as a whole. Fig. 7, for example, shows how

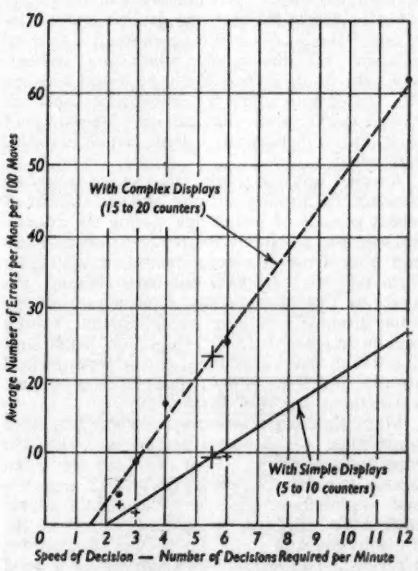

With Complex Displays
(15 to 20 counters)
With Simple Displays
(5 to 10 counters)
Average Number of Errors per Man per 100 Moves
Speed of Decision — Number of Decisions Required per Minute

Fig. 7—Effects of increasing the required speed of decision

the average error score for twenty men rose when more and more decisions were demanded per minute. This was done by speeding up the clock on which the timetable was based.

A less obvious problem than speed stress is the effect of the number of objects being shown on the display. Even when the pace is reduced in proportion to the increase in the number of units, there is a considerable effect due solely to this aspect of the perceptual load. For a given average speed of work, the errors will mount up with more items to consider if delay is penalised. Fig. 8 shows, however, that this effect is made even more serious when speed stress is added to load stress (Mackworth and Mackworth, 1956*b*).

Conrad (1951) has shown, too, that twice the load and half the speed of work does not lead to the same level of achievement as before. Doubling the number of spindles which a worker has to watch produces difficulties which may not be removed by halving the rate at which each spindle requires attention. Laboratory studies help to tell us how this comes about. First, as in Fig. 7 and Fig. 8, every extra item added may

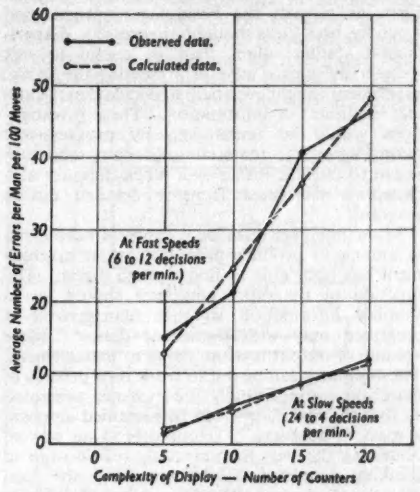


Fig. 8—Effects of increasing the complexity of the display

bring with it more and more signals of no importance which have to be neglected, and which hamper visual search. Obviously there will be more difficulty in finding the next urgent signal from amongst a hundred signals than in picking the next one from twenty signals. Correcting the time allowed to the extent only of making the number of decisions demanded per minute the same as before will not compensate for this difficulty when, as it were, the controller is being blinded by insignificance. For example, to pick out a two-figure number by eye from a few score such numbers will take about four times as long as choosing the same pair from only half a dozen (Baker, 1955).

Secondly, the introduction of extra items to watch can lead to trouble in a rather different way, and this can occur even when the average pace set by the machine is relatively slow ; here, the basic trouble arises when two or more signals overlap in time and both signals have to be seen immediately. Signal overlap can obviously take place even when the decisions demanded per second are relatively few. It has been shown that under certain conditions a good index of the difficulty due to signal overlap is the number of seconds that any given signal overlaps with any other signal (Mackworth and Mackworth, 1956*a*).

Obviously in, for example, the Russian display two or more emergencies might flash on and demand simultaneous action. This is the third problem that may arise from simultaneous signals on a display ; the decision as to the correct sequence may give some difficulty especially if their order of arrival has to be remembered, or if one emergency should have priority. Some recent unpublished work has shown that at very fast decision speeds, when a whole series of questions has to be answered, it may be best to show only the present problem and the one after that. At slow speeds, however, it is better to give three problems ahead rather than two, so that the operator may have time to plan his moves. Perhaps at very fast speeds it is more difficult to remember the relative order of the incoming problems (Mackworth and Mackworth, 1956*b*).

It is often, however, not enough to take things as they come, and machines can, of course, be devised to give priority to signals from any specially important sources. No one who is

working fast should have to search and pick out these priority signals for himself. Telford* made much the same point in discussion when he emphasised the advantages of automation in improving the quality of information provided to directors and management by an automatic office. The computer may print its " answer " in a book several inches thick and on each double foolscap page there may well be nothing but rows and rows of numbers. But the computer can also compress and digest information into its salient features. It is therefore up to the management to decide for the computer designers just what information is going to be essential for the particular executives they have in mind. First, as regards the basic facts needed, and secondly, how these should be expressed. Experimental studies might then be useful to test various alternative ways of presenting the facts ; experiments might even help to decide the irreducible minimum of information. These investigations would be undertaken by progressively paring away the material until comprehension began to fail, i.e. rather as a block diagram of a circuit is simplified from a detailed circuit diagram.

Many planners of office computers have erred in aiming to produce more data than management has been able to find time to digest. The function of the office computer should be to simplify information so that management is presented only with significant data. " Mere volume of output is of no value to management. The computer can be put to work on a process of detection, sifting rapidly the evidence presented so that the real culprit can be identified amongst a mass of suspects." (Hooper.*) One way of obtaining the best man-machine relationship in thinking problems is at times when the man asks the machine which of a number of different alternatives is the correct answer. He can do this by pressing a series of buttons according to the various possibilities. This approach combines the flexibility of the human brain with the remarkable speed of the electronic brain.

Hooper* makes the further point that when people dream about members of the management sitting before screens showing exactly what is happening from moment to moment, " it must always be remembered that a computer cannot think originally or intuitively, determine its own instructions or perceive or interpret any situations which may arise outside the precise instructions to it." Although this is true, I believe that more use might be made of the limited amount of machine prediction already possible with existing servo-systems.

Let me end this rather futuristic section on a note of admiration for engineering efforts to make the machine an effective controller, in case I should be thought to be biased in favour of human thinking. Young* mentions the possibility that a computer could not only control a chemical plant, but it could at the same time gradually determine the best operating conditions for the plant by finding those likely to give the highest yield of the given product. There is something completely fascinating in this idea that this master computer could solemnly carry out the necessary experiments by following a well-balanced statistical plan fed into it by the plant manager. McCallum* goes further and adds that " to establish whether a petroleum plant is running at a level of optimum profitability it is necessary to carry out very lengthy and time-consuming calculations. These calculations can readily be done on a computer, and it should be possible in the future to integrate such calculations with direct control of operating variables in the unit." Feed-back for self-service is to be expected nowadays, but this kind of self-help and self-advancement is quite remarkable.

Training of Electrical Maintenance Workers

It is a striking fact that two-thirds of those who addressed the 1955 Margate Conference mentioned this problem of the maintenance of automatic machinery. No other matter drew quite so much attention as this topic, which occurred in as many as fourteen of the twenty-one papers presented at the meeting.

* *The Automatic Factory—What does it mean ?* Report of the Institution of Production Engineers Conference at Margate, 1955.

Learning Electrical Ideas by Their Use

Johnson (1951) has been working on the evaluation of a more effective method of training electronic technicians for the U.S. Navy. These were men of eighteen to twenty years of age, who had to be given the rudiments of the subject in as short a time as possible, without lowering standards of knowledge or practice. None of the learners had any previous direct experience of electrical matters.

The usual method of instruction was compared with the experimental method. Seventy men took part in each section of the experiment. These two groups of people were matched for general ability and education by ensuring that for each man in one group it was possible to find someone in the other group who was similar in both respects.

The usual method divided the time equally between lecture and laboratory, with the lectures subdivided into mathematics and theory. The laboratory experience was intended to give practical exercises in applying the theory and the mathematics. Laboratory classes were about thirty men per instructor, and lecture classes ranged in size up to about sixty students for a single instructor. One instructor taught two periods of mathematics daily, a second instructor gave two periods of theory and a third instructor did four periods of laboratory work. The course was described as being academic with little credit for practical work.

The experimental method was designed to bring together practice and theory more closely, each class has its own instructor in the same room throughout the course, and the same man taught all the laboratory work, theory and mathematics. Class size was limited to fifteen. The essential point of this method was, however, that the students learned the more abstract subjects as they built electronic apparatus. There was a greater emphasis on practical work and the mathematics taught was limited to that which was essential to understand the theory or the laboratory constructional work. The theory and mathematics were introduced in such a way that they were taught when and where they were needed to undertake the laboratory work.

The results were that the seventy people in the experimental group needed only eighteen weeks to reach the same level as the usual group reached in twenty-six weeks. No differences in knowledge could be found between the groups on a series of multiple-choice questions concerned with shop practice and direct and alternating current. Similarly, no differences could be found between the two groups during a subsequent spell of sixteen weeks under very careful observation of their daily practical work with actual electrical equipment.

Another way the results were analysed was to consider the training wastage, and the number of repeat periods of instruction during the course. Six men had to be rejected from the usual group and none from the experimental group (apart from two who dropped out from illness). As many as thirty-one of the seventy men in the usual group had to have repeat periods, lasting usually one to two weeks during their course, and this was in striking contrast to the experimental group, none of which required any repeat instruction.

Many different reasons were believed to have contributed to the advantages seen with the experimental course. First of all, in the usual course, two days out of ten were spent in review and examination. In the experimental course each day's work opened with a review of the previous day, and no special day was allocated for a review. The learner was undertaking a good deal of self-review because he was constantly having to build into his equipment the subject-matter he had just learned. By learning as he built the student was teaching himself much of the time with, however, advice when needed. Secondly, this combination of theoretical and practical work made it possible for the student to work on simulated work situations. A close relationship was established between learning activities and needs, and this eliminated a considerable amount of subject-matter specially on the mathematical side, without reducing in any way either the practical or general efficiency of the students. Thirdly, frequent brief examinations were used as teaching devices in the experimental course to discover any weak spots in knowledge as quickly as possible.

Obviously there are many differences between training in an American Services situation and training in an industrial situation in Britain—and this method of teaching may indeed already be fairly well known here. The main purpose of presenting this example is not only to give one possible approach to short-course instruction, but also to illustrate a quantitative way of thinking about the evaluation of training methods. It is particularly in this quantitative way of considering training that applied experimental psychology has much to contribute (and much to learn), as for example, in the measurement of achievement during and after training.

Measurement of Fault Location

Simulation of the tasks facing electronic maintenance men, although not easy, is much less difficult than it would be in many other forms of work. Technical colleges are now using this approach of actual circuits which provide standard faults as training devices in the diagnosis of particular defects. It is thought, however, that there is a whole new field for research on the question of how people do, in fact, locate faults in a circuit. Surprisingly enough, much less is known about this than about predictions on the most satisfactory way to find a defect (Miller, Folley and Smith, 1953 ; Gagné, 1954).

Dale (1955) in some interesting unpublished work describes how he has started to investigate fault location. Twenty-four untrained adults were provided with a series of problems which took the form of a number of items arranged in chains. Fig. 9 shows that these chains had

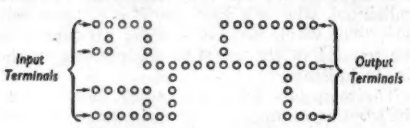


Fig. 9—Circuit problem

several input and several output terminals. The subjects were told to find the faulty item in the " circuit " and were asked to begin each problem by checking every input and output terminal. They were then to proceed by checking one item at a time, taking these in any order but always attempting to make as few checks as possible in locating the one faulty item. (These items were small cardboard squares bearing marks representing (1) input correct and output correct, or (2) no input and no output. One card was the faulty item and this had (3) input correct but no output. These squares were placed face downwards to provide the need for search among the items.)

The logical way to solve this problem was to begin by making a check such that the probability that the fault lay towards the input side of this check was equal to the probability that it lay towards the output side. With branching chains, however, it was better to start checking at points which would eliminate whole branches of the system. To find the fault in the circuit shown in Fig. 9, for example, a total of five checks is sufficient, and one possible solution is given in Fig. 10.

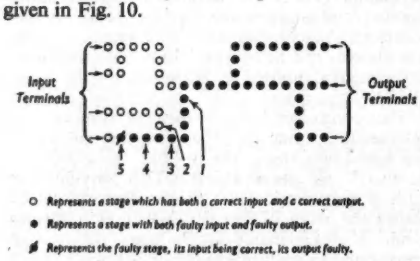

Input Terminals
Output Terminals
5 4 3 2 1
○ Represents a stage which has both a correct input and a correct output.
● Represents a stage with both faulty input and faulty output.
Ø Represents the faulty stage, its input being correct, its output faulty.

Fig. 10—Circuit answer

Less than one-half of the checks actually made by the twenty-four untrained men were placed at the most favourable points in the system. There was a tendency to be over-cautious, i.e. to make checks which were too

close to the previous check, and, therefore, provided very little additional information. One possibility that is now being considered by Dale (1955) is to discover whether the choice of check points is modified by the actual layout of the circuit diagram.

This work needs confirmation by the presentation of similar problems to trained electronic fault-finders, but it has already brought up the possibility that training in the best methods of search might reduce the time and effort required to pin-point a fault in an electrical circuit. Many other factors have to be introduced into the experiment. It is believed that the investigation has implications rather more for fault location within a given machine unit. It may, however, also be useful in first-line maintenance under circumstances where no effective warning light system indicates the faulty machine unit. In the first-line maintenance problem each machine unit is to be regarded as a component in the "circuit," which then becomes a "block diagram." The main objectives of further work are to elucidate the factors underlying effective training in fault location. The method is to consider what people do in fact do, in addition to what they ought to do and what they might do.

THE FUTURE SUPPLY OF ELECTRONIC STAFF

The more that machines take over the tasks of industry, the more highly trained the maintenance men will have to be. There are many people to-day who believe, and find their belief confirmed by life, that education is useless after you have learnt to read the daily paper and to do the football pools. Mathematics is for them useless drudgery, the learning of the multiplication table to be promptly forgotten along with everything else placed before them at school. Yet boys spend the ten most formative years of their lives at school, and almost every child is filled with a passionate curiosity to find out about everything. Somewhere along the line the most valuable asset of the human race is destroyed and in its place comes the desire to get by with the least effort. If you want, as you will, millions of men able to understand electricity, it is necessary to go right back to the early days of school to use and keep alive that invaluable curiosity. Nothing is more difficult than learning to talk, or to read and write, things which all but the very lowest grade take in their stride.

The child needs to know the use of what he learns. Teach him abstract mathematics and incomprehensible ideas about gravity and gases, and he is lost to learning for ever. But put a child old enough to have sufficient manual dexterity on to building his own transistor receiving set, and he is ripe to learn how it works and why. Education should be primarily aimed at making, for man is a maker before he is a thinker, and most of the best thinking comes from trying to understand how and why things act as they do.

So training must start in the schools, and the elementary schools at that. For this you need new teachers, a vast amount of new equipment and new examinations. Since none of this is likely to come from the Government, industry might use some of the money it now pays in taxes to found its own schools. However, this is, perhaps, in the very distant future.

Additive for Lubricants

A SYNTHETIC lubricant with a wide range of application is now being marketed in this country by Bardahl Products, Ltd., 9, Watling Court, E.C.4. It is intended to be added to oils and greases, including cutting oil, and to fit them for service under severe conditions, such as prevail in piston engines. Bardahl itself has lubricating properties which persist even at 1000 deg. Fah.; tests in the S.A.E. extreme pressure test machine gave values of 25 lb for an S.A.E. 30 oil and 235 lb for the same oil mixed with 10 per cent of the additive. This lubricating property is reflected in reduced friction losses in machinery, resulting both in improved performance and longer life ; also it is possible to use an oil of lower viscosity, thus saving power and easing starting from rest.

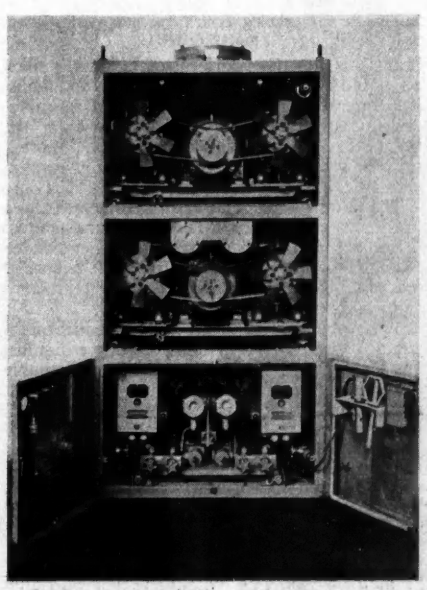
As an additive, Bardahl conveys detergency and acts as an oxidation inhibitor ; thus ring sticking, carbon deposition and sludging in internal combustion engines are expected to be reduced. In marine diesel installations, where large tonnages of oil are carried in order to retard oxidation, a 10 per cent admixture will allow the sump capacity to be made smaller by as much as a fifth. Also, this additive has the effect of increasing the adhesion between oil and metal, so that oil consumption falls ; with a system of mechanical lubricators a 20 per cent mixture has in some cases provided the same film with the expenditure of one-tenth as much oil. Tool life and output are claimed to improve when this additive is included in cutting oils, and it can beneficially be applied to die presses. Oils to which it has been added do not emulsify with water, but there is no change in the flash and freezing points. The additive, which does not contain acids, even after exposure to high temperatures, is supplied in containers ranging from 16 oz to 45 gallons.

Closed Circuit Dry Clean Air Supply

A SPECIAL diaphragm compressor set to provide shipboard supplies of dry, clean, oil-free air at low pressure has been evolved by the Hymatic Engineering Company, Ltd., for the Admiralty. The set, which is suitable for closed-circuit systems and is illustrated herewith, incorporates "main" and "standby" compressor units to facilitate maintenance while the set is in operation and to maintain supplies in the event of breakdown or damage. A ventilated steel cabinet houses the two compressor units, each of which has an output of 5 cubic feet per minute of free air at 35 lb per square inch, and each unit consists of a pair of Hymatic diaphragm compressors, Mark DP11, belt driven by a 1 h.p. electric motor mounted between them on a steel frame.

For each compressor there is a manual selector switch, a push-button starting switch and an indicator lamp powered through a pressure-sensitive switch which closes at pressures of 30 lb per square inch or more and opens when the pressure falls below 25 lb per square inch. Although the main unit selector switch is hand closed, that for the standby set can either be hand closed or set to an automatic position, whereupon it becomes an auxiliary, supplying additional pressure should the main unit fail to reach the required amount. In the automatic position the second set always augments the first, on starting the equipment, until the system has been filled with air and the pressure built up.

The output air drying apparatus at the base of the cabinet is also duplicated and a window, in each of the two cylinders containing silica-gel, permits the moisture state of the contents to be seen, so that the fresh cylinder can be brought into circuit when the other is exhausted. The silica-gel, which turns pink when exhausted, can be reactivated by heat. On its way to the dryers the air passes through a 5-gallon receiver which damps out delivery pulsations and collects moisture from the air.



Compressor set seen with covers removed

A diagrammatic arrangement of the piping of the set is shown in our line drawing. Venturi pattern unloaders are fitted in the delivery line, and until the motors have reached their normal speed the compressors are running against no load and delivering to atmosphere. The make up valve, which admits air on starting until the system is fully charged at the pressure required thereafter only admits "make up" air. From the make up valve air is drawn through a shut-off valve to the two compressors in tandem and then through a non-return valve to the air receiver. From here the air passes through one or other of the drying and filtering stages, each of which may be isolated by closing the appropriate valves. A relief valve set to open at 50 lb per square inch is fitted to each compressor, but will not normally function unless both sets are in use. A single set will maintain the system at about 40 lb per square inch. Opening the receiver drain valve reduces the pressure in an emergency and resetting the shut-off valve on the input side adjusts compressor performance to meet any change in operating conditions. When a set is not running it is isolated from the receiver pressure by a non-return valve in the output line.

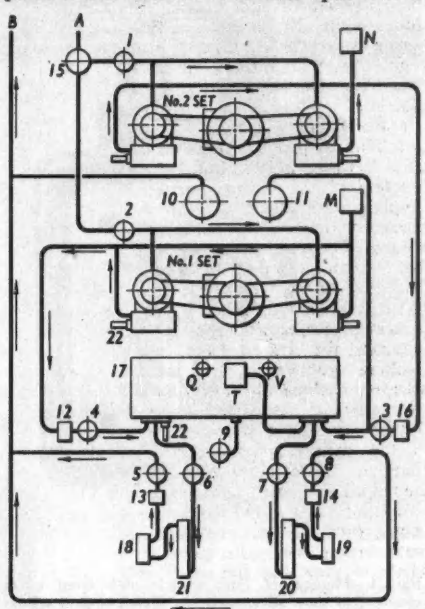


Diagram of piping of compressor set

Each compressor consists of a single pump in which reciprocating motion is imparted to a diaphragm through a connecting-rod from a crank in a pulley-driven shaft, which has on its outer end a fan to draw cooling air past the compressor case. A grease-packed bearing used at the crank ensures that the incoming air, which is drawn into the crankcase through a filter, is not contaminated by oil. A reed pattern inlet valve on the diaphragm admits the air to the pump chamber, while a similar valve in the pump head discharges it. Laminations of high-temperature synthetic rubber, reinforced with nylon and lubricated with silicone grease, are used for the diaphragm.

The frame on which each pair of compressors is mounted is secured to the fabricated steel cabinet through four sound-insulating and shock-absorbing rubber bushes. Further sound and shock-proofing is provided by rubber bushes at the base of the cabinet, waterproofing strip at the edges of the removable front panel and methacrylate windows in the pressure gauge apertures. A flexible steel band holds each compressor in its frame, and it can be removed by slackening a hand nut and disconnecting two pipes. Access to fuses, &c., is by means of partial withdrawal of the air receiver on the rails provided, and accommodation is arranged in the terminal block for either a.c. or d.c. circuits, the reversible under-plate having a.c. connections on one side and d.c. on the other.

Flameproof Limit Switches

A FLAMEPROOF version of the "Acme Snap-Lock" switches introduced in 1953 has been developed and made by B.S.A. Tools, Ltd., Kitts Green, Birmingham. It is designed to comply with the requirements of B.S. 229 and 587, and is Buxton tested to carry the "FLP" mark. It is stated to give safe operation with class I gases, such as methane, and class II and III gases, including blast-furnace gas, and hydrocarbons encountered in the petroleum industry.

The mechanism of the flameproof switch is identical with that of the standard "Snap-Lock" switch. It is a single-phase, or d.c. double-circuit, or two-way switch having one circuit normally closed and one normally open which can be reversed by moving the return spring

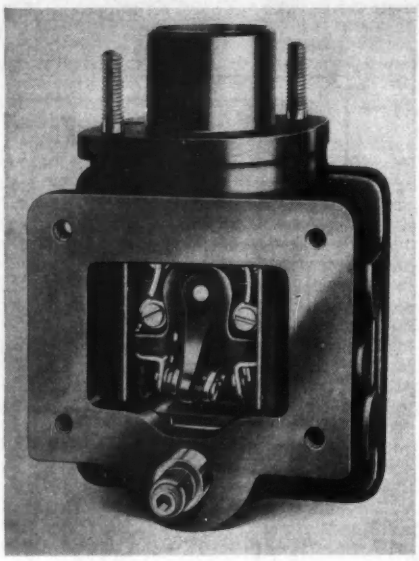


Fig. 1—Flameproof limit switch with front cover removed to show silver contacts, stainless steel splines for locating operating lever, and projecting insulation forming creep barrier

to the side required. With the return spring removed completely the operating lever must be used to reset the switch or make contact in the opposite position, thus providing a double-throw switch which is "maintaining" in both positions. The operating lever is mounted on a splined shaft and can be adjusted for position in steps of 7·5 deg. through 360 deg. To comply with the National Coal Board's directive that no aluminium die casting may be used in dangerous locations, the switch is housed in "Meehanite" iron castings. Provision is made for mounting the switch by two $\frac{1}{16}$ in B.S.W. tapped holes, one on each side face.

Instead of the usual separate flameproof terminal chamber which would have been so small as to be inconvenient, a four-pin plug and socket has been introduced. The body of the plug forms the compound filled sealing chamber. The provision of a plug and socket on the switch speeds up the location of a circuit fault as, when the plug is removed, both the line and switch leads are accessible for testing. All plugs and sockets are interchangeable. The plug is correctly shrouded to flameproof limits at the moment of "breaking" and the plug securing studs are asymmetrically placed to ensure correct location. An improved design of plug and socket contact is used in the switch, the contact elements being silver-plated. The mechanism provides for a small amount of wiping action on the "make" and "break" motions of the contacts, which are of solid silver. The "Snap-Lock" unit is mounted in the main body and removal of the front plate exposes the electrical side (Fig. 1). Insulation around the terminal blocks provide the necessary creep barrier to earth.

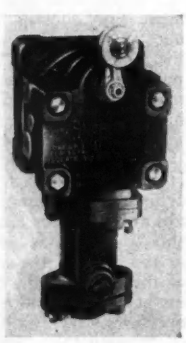
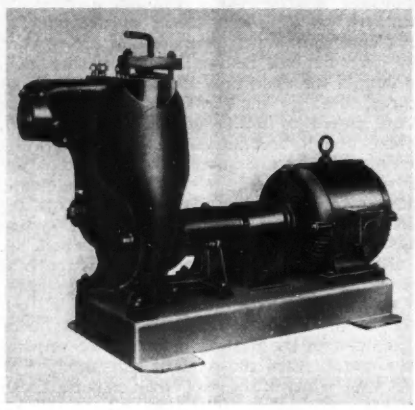


Fig. 2—Flameproof limit switch complete with sealing chamber which also forms the body of a plug and socket connection

The switch is operated by a 10½ deg. movement of the operating lever, which has an effective length of 1½in. The overtravel spring permits 28½ deg. of overtravel in either direction, but it is not recommended that more than 6 deg. be used if the operation is frequent and rapid. A shear pin is fitted to the operating spindle inside the overtravel spring, to protect the switch mechanism in the event of excessive overtravel. Normally, the standard operating lever, as shown in the view of the complete switch (Fig. 2) is supplied, but special levers to meet individual requirements are available.

Self-Priming Centrifugal Pumps

A NEW range of automatic self-priming centrifugal pumps is now being made by Sigmund Pumps, Ltd., Team Valley, Gateshead, 11, in eight models with branch sizes from 1¼in to 8in and outputs from 30 to 1600 gallons a minute. This design of pump needs no foot valve, and is stated to give efficient self-priming on suction lifts up to 25ft. The casing is so designed that during priming the air and water mixture from the impeller is delivered through one volute channel into a priming chamber above. From this chamber the water flows down again through an adjacent volute channel into the impeller periphery to mix with any air still being delivered with the incoming water. This action continues until only water is delivered through the two volute channels and out through the discharge



Automatic self-priming centrifugal pump with direct motor drive

branch. Once the pump casing is initially filled no liquid circulates within the pump, and whilst it is operating the pump primes and reprimes, clearing any air or gas which may enter the suction line. It is capable of automatic "snore" operation over long periods when the suction pipe inlet is only partially submerged.

The pumps are available with either belt drive or directly coupled to an electric motor as shown in the accompanying illustration. They can be modified and supplied with parts made in special materials to suit them for handling petroleum spirit and other inflammable liquids.

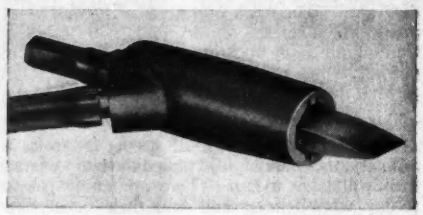
Removable wear plates are fitted to reduce maintenance costs when handling abrasive liquids, and the open impeller used is stated to be capable of handling solids up to 25 per cent of the suction inlet diameter.

STUD WELDING TOOL ANGLE ATTACHMENT.—An attachment for the "Nelson" stud welding tool, which has been developed by Crompton Parkinson, Ltd., enables studs to be welded at right angles to the tool. The attachment is fitted on the tool in place of the standard chuck and leg assemblies by means of the three screws which are normally used to hold the adjustable leg bracket in position. It can be fitted at any angle relative to the hand grip of the tool to facilitate use in confined places or to avoid obstructions.

Dust Collection from Fettling Chisels

To provide a means of removing dust created at the chisel edge when using pneumatic chipping trimmers for fettling castings a dust collection sleeve, which is illustrated below, has been developed by the Destructor Company, Ltd., Hayle, Cornwall. With this sleeve dust collection takes place at about an inch from the chisel edge, and it is drawn through slots on the inner surface of the sleeve. These slots form ducts between the sleeve and the chisel surface and open out into a branch at the top of the sleeve. This branch is connected to the dust collection equipment.

In the dust collection equipment a vacuum of 5in of mercury is required, and at this depression a sleeve passes 6·5 cubic feet of air per minute. The sleeves are used with the makers' collector and filter equipments, which can be used with either a venturi suction apparatus,



Fettling chisel fitted with a dust collecting sleeve. Dust from the chisel edge is drawn through slots up this sleeve and passes through a hose into a collector-filter equipment.

known as an "Eductor," or with a multi-stage exhaust fan or rotary exhauster. A collector-filter unit can serve up to four chisels when using the pneumatic "Eductor," or up to ten chisels can be served when using an electrically-driven vacuum source.

The sleeve is prestressed on the chisel by means of an annular ring ground in the chisel. As the chisel is shortened by sharpening, the sleeve can be cut back to maintain its face about 1in from the cutting edge. The sleeve is connected to the dust collecting equipment by a light plastic base.

British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 2, Park Street, London, W.1.

TESTS FOR USE IN THE APPROVAL OF WELDERS. PART I: MANUAL METAL ARC AND OXY-ACETYLENE WELDING OF MILD STEEL AND LOW ALLOY STEEL SHEETS, PLATES AND SECTIONS

No. 2645, Part I: 1955. Price 12s. 6d.—Part I forms one of the standards in the comprehensive series authorised by the Welding Industry Standards Committee. It has been prepared to make available a series of standard tests, one or more of which can be selected for assessing or testing the capabilities of a welder. It is complementary to B.S. 1295, "Tests for Use in the Training of Welders," which details tests to assess the progress of trainees. It is emphasised that the tests cover various thicknesses of material, normal forms of joints and various welding positions.

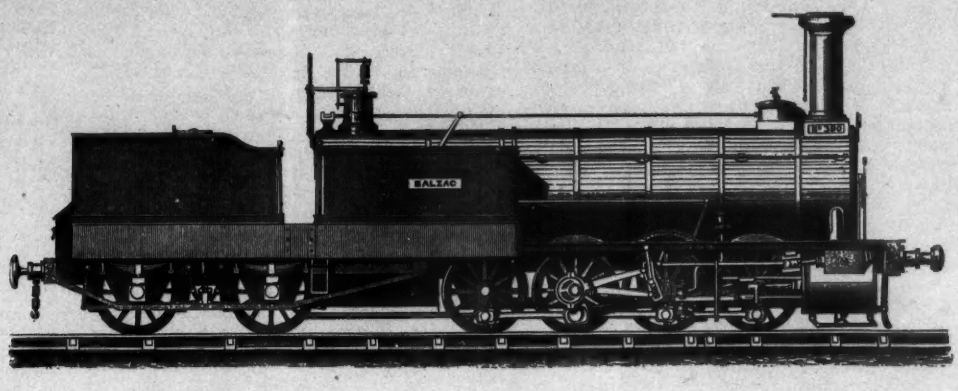
The tests in Section 1, for which the specified material is mild steel, are for use in the preliminary assessment of a welder's skill. They are designed only to ascertain if a welder is familiar with the usual techniques of metal-arc and oxy-acetylene welding, as applied to flat steel products (sheets, plates and rolled sections). The tests in Section 2 are for use in the approval of welders for specific applications. They compromise butt and fillet welds made by the metal-arc and oxy-acetylene processes in steel sheets and plates, as may be specified.

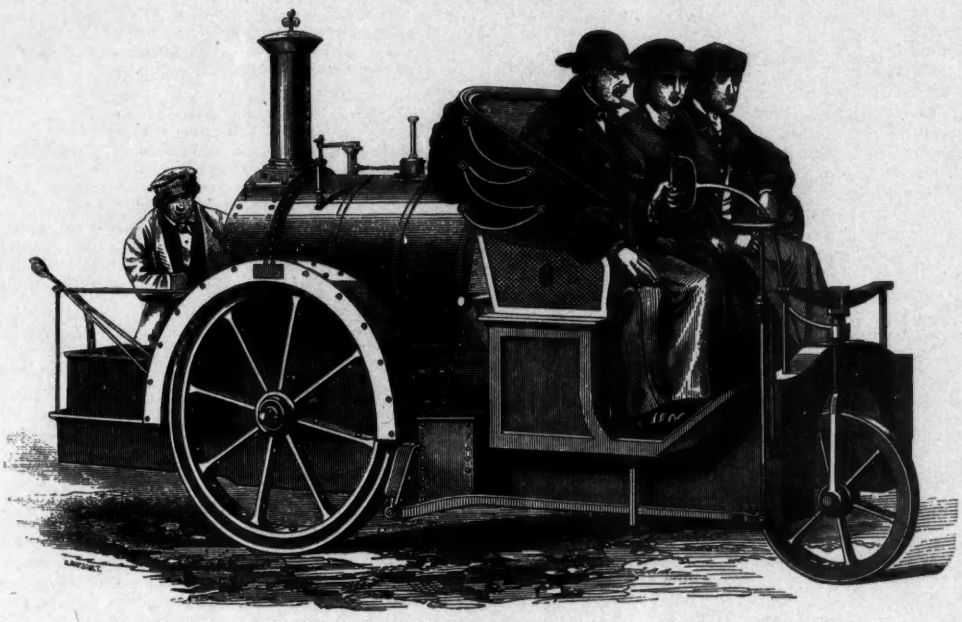
A welder who passes certain of the more difficult tests may be assumed capable of passing some of the simpler tests. Hence, in deciding on the test to be applied to a particular welder, it will often be found possible to select only one of those corresponding to the more difficult joints on which he will be employed, thus keeping to a minimum time and expense of testing.

The welding procedure, preheating and post-heating, and the specifications for the electrodes and filler rods to be employed, particularly for the welding of low alloy steels, should be in accordance with the application standards where these exist or in the absence of such standards they should be stipulated. The Appendices give notes on the alternative sizes of electrodes, illustrations of welding positions, and a suggested method for preparing etched specimens.

Engravings of 1860

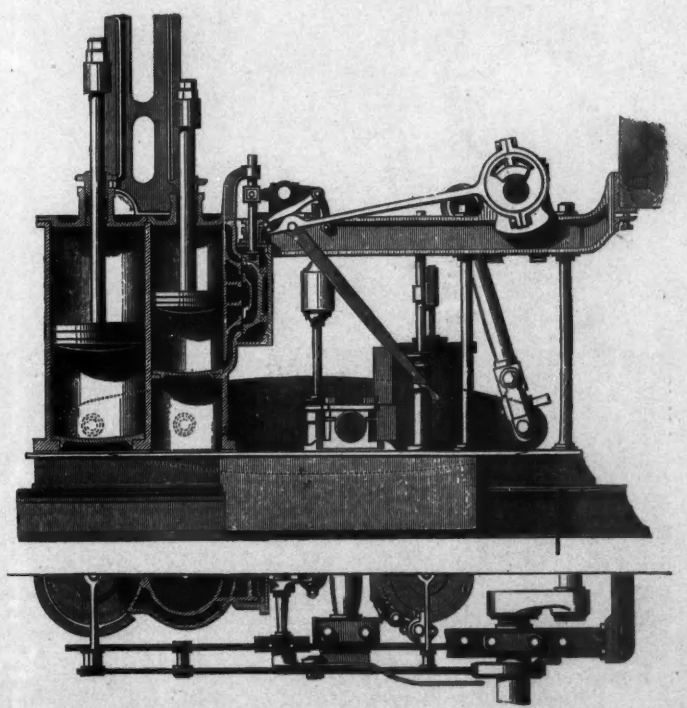
This engraving, reproduced from our issue of May 11, 1860, shows one of the heavy Engerth engines made by Schneider and Co., of Creusot, for the Northern Railway of France. In describing the engines we wrote :—"The tender is made to carry a considerable part of the weight of the engine, the framing of the tender extending along the fire-box, which it partially supports, and coupling to the engine-frame through a joint under the middle of the boiler."





The issue of October 19, 1860, included the accompanying engraving of the Earl of Caithness's steam carriage, in which he had "lately travelled from Inverness to his seat, Barrogill Castle, within a few miles from John 'Groat's House." Lord Caithness stated that such a feat as going over the Ord of Caithness had never before been accomplished by steam, as he believed that the carriage rose "about 1000ft. in five miles." The only details given about the carriage were that its cylinders were 3ins. in diameter with 7in. stroke, and that on the level its speed was as much as nineteen miles an hour! It was also stated that the vehicle carried water for ten or twelve miles and coal for about twenty miles; it weighed about two tons "when full and ready to start." Lord Caithness expressed the opinion that his carriage did "the roads much good". Our general comment was that "ere long, steam travelling upon the highroads will be availed of to a large extent."

This engraving illustrates a "single beam-engine, with compound cylinder, for small towing boat on the Lake of Geneva in Switzerland." A description, published on February 17, 1860, contained the following:—"The boat is 90ft. long by 13ft. beam, and draws 3ft. of water, including the keel, her displacement at that draught being 40 tons, and midship section 27½ square feet. The nominal power of the engine is 25 horses. The two cylinders are cast in one piece, the distribution of the steam being effected by one slide valve common to both cylinders. The diameter of the smaller cylinder, into which the steam is first admitted, is 15in. and the length of its stroke 23in. The diameter of the larger cylinder is 20in. by 3ft. stroke. The beams are of wrought-iron of unequal length between the centre and ends, so that, while the larger cylinder has 3ft. stroke, the length of the crank is only 1ft. The boiler is of the usual tubular description, with half-round steam chest, and the pressure to which it is loaded is 60lb. per square inch. The consumption of coal is 160lb. per hour on an average of twenty trips. This gives about 6½lb. per nominal horse-power per hour, including getting up steam twenty times and stoppages at stations." The steamer, we stated, was made by Escher Wyss and Co. at Zurich.



Continental Engineering News

Geesthacht Power and Pumping Station

The development of the hydro-electric and pumping station at Geesthacht, on the Elbe, about 35km from the centre of Hamburg, is one of the most important enterprises undertaken in Germany since the war. Construction was begun in December and by the time it is completed an estimated total of DM.155 million will have been spent. The scheme is to consist of a dam creating an increase in level of 3·5m. This is to be exploited by means of seven turbines, which will generate a total of up to 20MW. A canal, 5km long, together with a lock (eventually a double lock) will serve to maintain shipping traffic. The neighbouring Geestrücken hills, which are about 80m high, make it possible to construct a pumped reservoir of 3·3 million cubic metres capacity above Geesthacht. With a difference in level of 70m to 85m, this corresponds to a capacity of some 580,000kWh. Penstocks of 3·5m diameter and approximately 612m length will connect the reservoir with the power-house on the river. This station is to be equipped, in the first instance, with three turbine sets totalling 105MW. Each set will consist of a Francis turbine of 57 cubic metres per second at 214 r.p.m., a motor generator of 35,000kW, and a pump rated at 33 cubic metres per second. In the second stage, the complete installation will have six sets producing a total of 210MW.

The project marks the first step towards improving the navigability and control of the whole of the River Elbe.

Portal Jib Cranes for German Shipyard

Modern trends in ship construction are towards the prefabrication of increasingly large sections of the hull, such sections being subsequently assembled on the slipway. This procedure substantially reduces the time any particular ship is on the slipway and thereby greatly increases the output capacity of the yard. To make full use of prefabrication, at the rebuilding of the Blohm and Voss shipyard at Hamburg it was decided to install portal double-jib cranes with a maximum capacity of 40 tons each. By using two cranes, sections of over 70 tons can be transported.

Two 40-ton capacity portal cranes at the yard of Blohm and Voss, Hamburg

Our illustration shows the two cranes at this yard. They were built by Demag Aktiengesellschaft, Duisburg, German Federal Republic, and are of the " Model S " design. With these cranes the rotatable superstructure turns in a double roller bearing of 4·5m diameter which can sustain both compression and tension forces. Access to the cabin is obtained through this slewing ring without danger even while the crane is working. Luffing is carried out by means of a hydraulic cylinder acting on the boom. The design incorporates a safety device against overloading at any particular radius of the load. The device consists in arranging the base of the winch so that it can swivel about a horizontal axis against spring resistance. Movement of the base under load is transmitted by a " teleflex " cable to an electric differential which is also connected to the boom. Should the permissible load be exceeded at any radius, the mechanism switches the winch off.

The " Model S " crane can handle loads from 6m below base to 40m above, at a maximum radius of 37·5m, and with its derrick in the fully raised position stands 62m high. The agent in the United Kingdom is Aabacas Engineering Company, Ltd., 25, Grange Road, Birkenhead.

Austro-Soviet Trade

Trade between Austria and the Soviet Union is reported to have increased substantially last year, in particular after the withdrawal of occupation forces. In 1954, Austria imported from Russia goods valued at 36,000,000 schillings, while exports amounted to an estimated 38,000,000 schillings. In the first eight months of last year, imports into Austria from the Soviet Union were valued at 61,000,000 schillings, while Austrian exports in the same period were down to 2,700,000 schillings. However, in the following three months (September-November), Russia exported 28,600,000 schillings' worth to Austria, while Austrian deliveries, excluding those on reparations account, amounted to 99,700,000 schillings, bringing the total in the first eleven months of the year to 102·4 million schillings. A sum of 18,000,000 schillings, earned from business on Soviet account with third countries, should be added to this total.

The Soviet Union was the fifth largest importer of Austrian goods in November, after the German Federal Republic, Italy, the United States of America, and Switzerland (in that order). After Russia came the United Kingdom, France, the Netherlands and Poland. Soviet imports from Austria in November included industrial machinery, electrical equipment and power station turbines, worth 27,000,000 schillings, ships worth 24,000,000 schillings and motor vehicles worth 11,000,000 schillings.

Eighth German Handicrafts and Trade Fair

The eighth German Handicrafts and Trade Fair will take place in Munich from April 27th to May 10th. Among the twenty-six main groups of exhibitors, German arts and crafts and applied art, furniture and interior decorating, fashions, clothing and textiles will be well to the fore. To these must be added a wide range of machines, tools and appliances, particularly those designed for the small firm or workshop. Several examples of completely equipped workshops, from woodworking to the repair of agricultural machinery, will be on view. Participation will be international, and it is expected that groups from many other European countries will again be represented on a similar scale to that of last year, when 25 per cent of the 1804 exhibitors came from abroad. Of the special shows which are in preparation, the chief ones will be " Modern Workshop Equipment," "Handicraft a Help for Housewives," " Mirror of Fashions," " Fashionable Shoes," and " Collective Group of German Arts and Crafts." The fair will be housed in ten halls totalling 365,000 square feet of floor space. Full information, including information on the available reductions in fail fares, can be obtained from the organisers, Verein fuer Handwerks-Ausstellungen und Messen e.V., Theresien-Höhe 14, Munich, 12.

Appointments

RUSTON AND HORNSBY, Ltd., Lincoln, announces the appointment of Mr. K. Wickham as assistant export manager.

AIR COMMODORE R. H. E. EMSON has been appointed director of armament research and development (air) at the Ministry of Supply, in succession to Air Commodore H. Ford.

SIR HAROLD SPENCER JONES, F.R.S., who recently retired from the position of Astronomer Royal, has been retained as a consultant by S. Smith and Sons (England), Ltd.

SIR WALTER J. DRUMMOND, M.I.C.E., M.I.Mech.E., has joined the board of Sigmund Pumps, Ltd., Team Valley, Gateshead, 11.

Business Announcements

BRENTFORD TRANSFORMERS, Ltd., states that all its departments have now been moved to a new factory at Manor Royal, Crawley, Sussex (telephone, Crawley 25121).

FORD MOTOR COMPANY, Ltd., states that it will shortly open at Aveley, Essex, a spares depot for the cars, trucks and tractors built at the Dagenham works.

DUNLOP RUBBER COMPANY, Ltd., announces the retirement, at the end of next month, of Mr. F. G. W. King, M.I.Mech.E., who has been technical director at Fort Dunlop for the past twenty years.

HEAD WRIGHTSON ALUMINIUM, Ltd., states that its commercial, buying, drawing, and design departments are now situated at the offices of the Head Wrightson Stockton Forge Division, Norton Road, Stockton-on-Tees (telephone, Stockton-on-Tees 65268). For the time being the company's works will remain at Thornaby-on-Tees.

HONEYWELL-BROWN, Ltd., announces the formation of a micro-switch division to manufacture and market the switches developed by its American associate, The Minneapolis Honeywell Regulator Company.

Contracts

PIRELLI-GENERAL CABLE WORKS, Ltd., an associated company of The General Electric Company, Ltd., has received a repeat order through its Canadian affiliate, the British General Electric Company (Canadian), Ltd., for the manufacture and installation of three further lengths of 301kV, oil-filled power cable, total length approximately 6000ft of cable, from the Aluminum Company of Canada, Ltd. The cable is required for the Kemano-Kitimat project.

SIMON HANDLING ENGINEERS, Ltd., Cheadle Heath, Stockport, has received from the Clyde Navigation Trust a contract, valued at £1,900,000, for an extension of the Meadowside Granary at Glasgow. The work to be done includes the supply and erection of the machinery equipment of a new 50,000-ton grain silo, together with three travelling pneumatic quayside plants, each capable of discharging 200 tons of bulk grain an hour from ocean-going ships, and extensive belt conveyor installations housed in steel gantries for transporting grain from the discharging plants to the silo.

BRUSH EXPORT, Ltd., has received an order for the supply and installation of equipment for the Chopan steam power station, Mirzapur, United Provinces, India. The order includes two 3000kW M.C.R. Brush-Ljungstrom turbo-alternators, two John Thompson water-tube boilers rated at 45,000 lb per hour at 425 lb per square inch and 775 deg. Fah., and Brush metalclad high-tension switchgear.

Miscellanea

HELICOPTER GAS TURBINE.—The Napier " Oryx " turbo-gas-generator has succeeded in its first attempt at a type test, running at 780 gas horsepower. The engine, which was described in some detail in our issue of August 5, 1955, page 196, has also carried out nearly sixteen hours' ground running in the Hunting Percival " P.74," which will shortly be flown. The " Oryx " will also power a larger Percival helicopter, the " P.105 " ; it is the first British gas turbine to pass a type test for helicopter application.

NORTHFLEET POWER STATION.—The Central Electricity Authority has received the consent of the Minister of Fuel and Power to the establishment of a new power station at Northfleet, Kent. It will be known as the Northfleet power station and will have an installed capacity of 720MW provided by six 120MW turbo-alternators, each steamed by a boiler unit having an evaporative capacity of 860,000 lb an hour. It is one of the new plants which will be designed to burn either oil or coal.